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John Muir

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COLUMBIA GLACIER

NOTES ON THE PACIFIC COAST GLACIERS

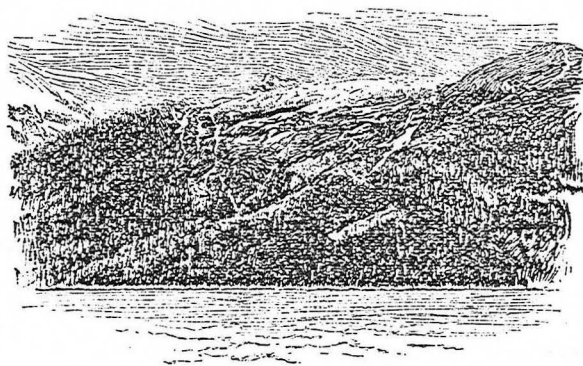
BY JOHN MUIR



HE glaciers that load the mountains of the Pacific Coast form a belt about two thousand miles long, of which the south half is mostly narrow and broken, the north continuous and broad.

On the Sierra Nevada of California between latitudes $36^{\circ} 30'$ and 39° there are sixty-five small glaciers, distributed singly or in groups of three or four on the northern slopes of the highest peaks at an elevation of 11,000 to 12,000 feet above the sea. These slow-flowing, ragged-edged, residual masses, few of which are more than a mile in length or width, are all that is left of the great glaciers which once covered the Range. More than two-thirds of their number lie between latitudes 37° and 38° and form the highest fountains of the San Joaquin, Tuolumne, Merced, and Owens rivers. Mt. Shasta, near the northern boundary of the state, still supports a few shrinking remnants, the largest of which is about two and a half miles long and descends to within 9,000 feet of the level of the sea, the lowest point reached by any glacier in California. Northward along the Cascade Range through Oregon

and Washington, groups of larger residual glaciers still exist on all the highest mountains—The Three Sisters, Mounts Jefferson, Hood, St. Helens, Adams, Rainier, Baker and others. From Mount Rainier, the highest of this series of volcanic cones, eight glaciers five to ten miles long radiate, descending to within 3,000 or 4,000 feet of the sea level. On through British Columbia and southeastern Alaska the broad, lofty mountains along the coast are usually laden with ice. The upper branches of nearly all the canyons are occupied by glaciers, which increase in size gradually and descend lower until the region which is highest and snowiest, between latitudes 56° and 61° is reached, where a considerable number discharge fleets of icebergs into the sea. This is the Iceland of Alaska, the region of greatest glacial abundance on the west side of the continent. It is about 500 miles long,



HANGING GLACIER, LYNN CANAL.

100 broad, and probably includes nine-tenths of the ice on the coast. To the north of latitude 61° the glaciers diminish in size and number to about latitude

$62^{\circ} 30'$ or 63° . Beyond this all the way up to the north end of the continent few if any glaciers now exist, the ground being comparatively low and the snowfall light.

In the iciest region the smaller glaciers, a mile or two to ten or fifteen miles in length, once tributary to large ones, now fill all the subordinate canyons and upper hollows of the mountains in countless thousands.

Of the great glaciers of the second class, flowing down nearly to the sea but not entering it, there are about a hundred, distributed along the coast from the mouth of the Stikine River to Cook Inlet and thence southwestward along the Alaska Peninsula, pouring their majestic crystal floods from far-reaching fountains in the recesses of the peaks, and sweeping down through the forests to the shores of the fiords or of the ocean. The expanded fan-shaped ends of many of them are from two to four miles wide, and all are separated from tide water by mud and gravel flats or terminal mo-

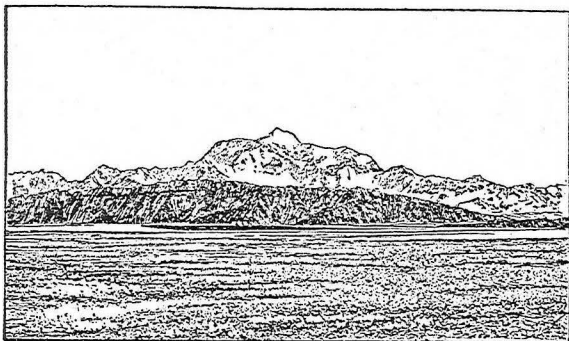


DAVIDSON GLACIER, LYNN CANAL
FRONT AND SIDE VIEWS.

raines—the waste from melting and evaporation equaling or exceeding the supply. The best known of this class are the Baird and Patterson, at the head of fiords opening

into Prince Frederick Sound, and the Auk, Eagle, and Davidson glaciers, seen from Lynn Canal; but the largest front the ocean along the Fairweather and St. Elias ranges. The Malaspina Glacier is the largest of all, being about twenty miles long and sixty-five or seventy wide, a vast plateau of ice at the base of the St. Elias Mountains, separated from the sea by a girdle of forested moraines

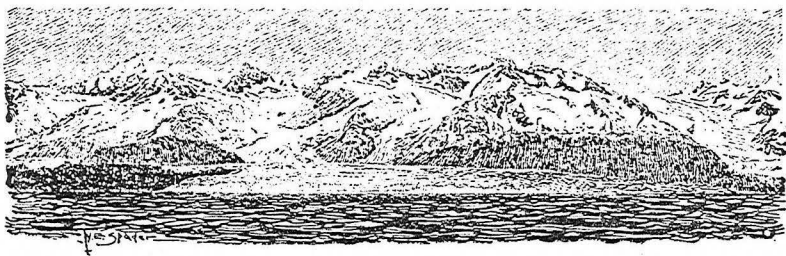
five or six miles wide, except at Icy Cape, where it presents magnificent bluffs of pure ice undermined by the waves. The broad outspread Miles Glacier, near the mouth of Copper River; the Yakutat, the Grand Plateau, Crillon, La Perouse, and many others are of the same



BROADSIDE OF MT. ST. ELIAS; MALASPINA GLACIER
IN FOREGROUND.

type though less extensive. La Perouse, like the Malaspina at Icy Cape, presents to the open ocean grand ice bluffs, which are washed and undermined to some extent at high tide by the waves

that occasionally detach berg-like fragments. These fragments are mostly small, however, and are speedily broken up and melted.



LA PEROUSE GLACIER.

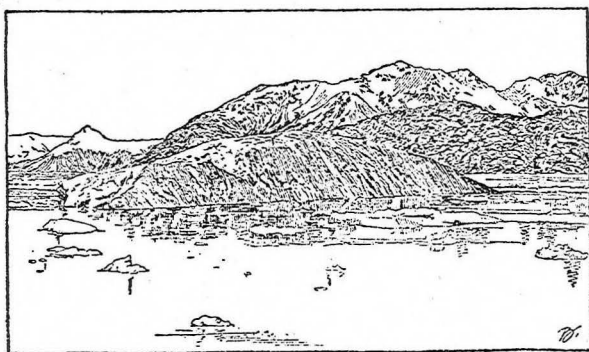
Of complete glaciers of the first class flowing out into deep ocean water and, of course, discharging bergs, I have seen twenty-eight, and there are at least three others, making thirty-one altogether, while several promising fiords in Prince William Sound remain unexplored. At the head of the LeConte Fiord, in latitude $56^{\circ}50'$, there

is one; about a degree farther north, at the heads of branches of Holkam Bay, there are four; in Taku Inlet there is one; in Glacier Bay there are nine; in Lituya Bay two; in Disenchantment Bay three; and in Prince



TURNER GLACIER, DISENCHANTMENT BAY.

William Sound eleven. All the fiords into which these glaciers of the first class flow are encumbered, some of them jammed and crowded, with bergs of every conceivable form, which by the most active of the glaciers are given off at intervals of a few minutes with loud thundering roaring that may be heard five or six miles, proclaiming the restless work and motion of these mighty crystal rivers, so widely contrasting with the deathlike stillness and



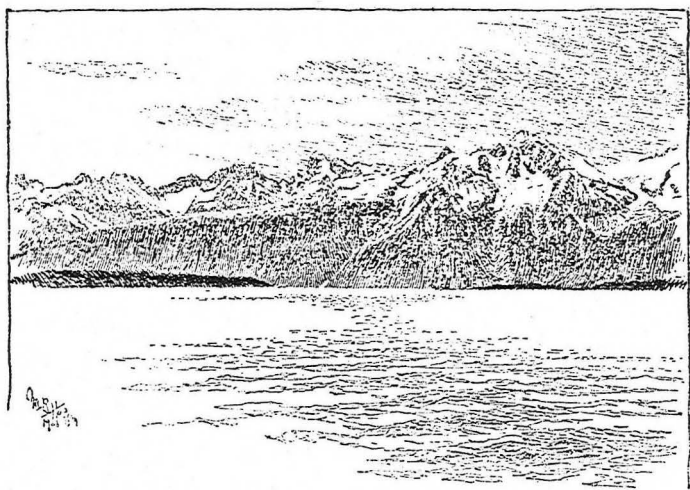
GIANT ICEBERG, GLACIER BAY.

(MUIR AND ANOTHER MAN ON THE TOP; BOAT IN FOREGROUND.)

silence of the second class decadent glaciers, though they also, except at their decaying ends, are ceaselessly

flowing and grinding, making soil, and completing the sculpture of their basins. As compared with the immense icebergs which adorn and guard the shores of Greenland and the Antarctic Continent those discharged by the Alaska glaciers are small. The very largest I have seen did not exceed a thousand feet in length, few of them three or four hundred feet. And, so far as I have observed, only from Glacier Bay, where the greatest number of bergs are born, do any of them escape to the open ocean. Nearly all are drifted back and forth by wind and tide in the long island-blocked channels until melted.

The southmost of the glaciers which flow into arms of the sea is the Le Conte. It occupies a narrow, forested, picturesque fiord about ten miles north of the mouth of the Stikine River, in latitude $56^{\circ} 50'$, called Hutli or Thunder Bay by the Indians, from the noise made by the rising and falling bergs.



MOUNTAINS ON LYNN CANAL OPPOSITE DAVIDSON GLACIER.

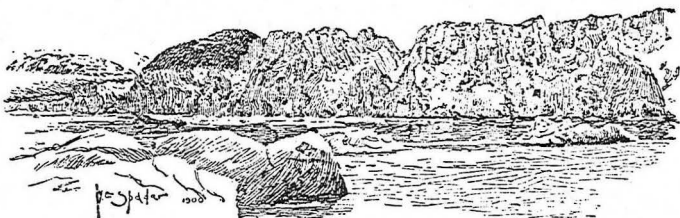
Holkam or Sum Dum Bay, the next icy inlet to the northwestward, is one of the most interesting of all the

Alaska fiords, but the bergs in it are usually far too closely packed to allow a passage for vessels of any size; oftentimes it is difficult to reach its glaciers even in the smallest canoes. About five miles from the mouth the bay divides into two main arms, about twenty and twenty-five miles long, in the farthest recesses of which its four glaciers are hidden. A hundred or more glaciers of the second and third class may be seen along the walls, and about as many snowy cataracts, which with the plunging bergs keep all the fiord in a roar. The scenery in both of the long arms and their side branches is of the wildest description, especially in their upper reaches, where the granite walls, streaked with waterfalls, rise in sheer, massive precipices, like those of Yosemite Valley, to a height of 3,000 and even over 4,000 feet.

The Taku Inlet, usually accessible to the tourist steamers, is about eighteen miles long, and drains many glaciers, great and small. Sailing up the middle of it one may still count some forty-five, descending from a group of high mountains at the head and making a grand display of their crystal wealth. Three of them reach the level of the sea; only one, however, the beautiful Taku Glacier, now discharges bergs. It comes sweeping forward in majestic curves and pours its countless roaring, plunging ice masses into a western branch of the Inlet, next the one occupied by the Taku River. Thus we have here in one view, flowing into the sea side by side, a river of ice and a river of water, both abounding in cascades and rapids, yet infinitely different in their rate of motion and in the songs they sing—a rare object lesson, worth coming far to learn.

Glacier Bay, about fifty miles long, with many deep, high-walled branches, is the iciest of all the inlets which fringe the coast. Both to the north and south of it the great tide-water glaciers are generally less active, less

lavishly snow-fed, and of course give birth to fewer bergs; while, as we have seen, the decadent second-class glaciers, with no ice to spare for bergs, reach their greatest size at the base of the St. Elias Range.



ICE FRONT OF MUIR GLACIER.

Of the nine berg-bearing glaciers in Glacier Bay the Muir is the largest, the main trunk below the confluence of the principal tributaries being about twenty-five miles wide, while the area of its basin can hardly be less than a thousand square miles.

The most active of the three Disenchantment Bay glaciers is the Hubbard, a truly noble glacier. It has two main tributaries pouring majestic floods into the broad, widely crevassed trunk, and it furnishes most of the bergs which fill the upper end of the bay from shore to shore.

The grandest and most active of the ten Prince William Sound glaciers visited by the Harriman Expedition,



SURPRISE GLACIER, HARRIMAN FIORD.

so far as I saw them, are the Columbia, Harvard, and Yale, though the Barry, Serpentine, Harriman and Surprise—the last

three discovered by the expedition—are also superb and imposing; while the cascading glaciers in Port Wells

Fiord named for Wellesley, Vassar, Bryn Mawr, Smith, and Radcliffe colleges are the finest and wildest of their kind, looking, as they come bounding down a smooth mountain side through the midst of lush flowery gardens and goat pastures, like tremendous leaping, dancing cata-racts in prime of flood.

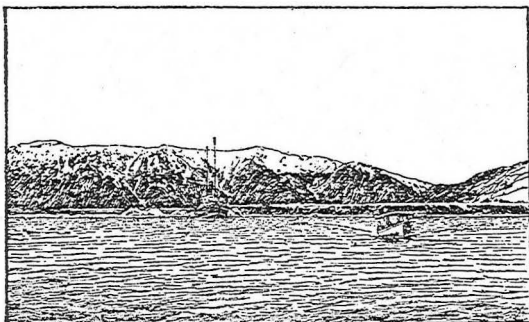


COLLEGE FIORD, PRINCE WILLIAM SOUND.

BRYN MAWR GLACIER ON LEFT; HARVARD IN DISTANCE.

None of the glaciers south of Icy Strait were visited by the expedition, though telling glimpses of them were obtained in the bright weather as we sailed through the enchanting Alexander Archipelago, the icy canyons opening and closing as we advanced and showing their wealth like the quickly turned leaves of a picture-book. In Glacier Bay we remained nearly a week, so that we were able to note the changes which had taken place since my first visit in the fall of 1879. I then sailed around the bay, exploring all its branches and sketching the glaciers which occupied them, sailing up to their discharging fronts and landing on those which were not rendered inaccessible by the freezing together of their crowded bergs. Then there were only six berg-discharging glaciers in the bay; now there are nine, the three new ones being formed by one of the tributaries of the Hugh Miller and two of the

Grand Pacific, separated from the main glaciers and rendered independent by the recession of the trunks beyond their points of confluence. The Hugh Miller and Muir have receded about two miles in the last twenty years, the Grand Pacific about four, and the Geikie, Rendu and Carrol

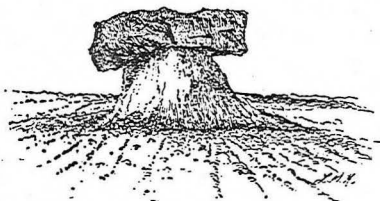


IN MUIR INLET, GLACIER BAY.

perhaps from seven to ten miles. By the recession of the Grand Pacific and corresponding extension of Reid Inlet an island two and a half or three miles long, and over a thousand feet

high, has been added to the landscape. Only the end of this island was visible in 1879. New islands have been born in some of the other fiords also, and some still enveloped in the glaciers show only their heads as they bide their time to take their places in the young landscape. Here, then, we have the work of glacial earth-sculpture going on before our eyes, teaching lessons so plain that he who runs may read. Evidently all the glaciers hereabouts were no great time ago united, and with the multitude of glaciers which loaded the mountains to the south, once formed a grand continuous ice-sheet that flowed over all the island region of the coast and extended at least as far down as the Strait of Juan de Fuca. All the islands of the Alexander Archipelago, great and small, as well as the headlands and promontories of the mainland, have a smooth, over-rubbed appearance, generally free from angles except where modified by the after-action of local glaciers, and they all have the form of greatest strength with reference to their physical structure and the action of an oversweeping ice sheet. The network of so called canals, passages, straits, chan-

nels, sounds, fiords and so on, between the islands manifest in their forms and trends and general characteristics the same subordination to the grinding action of a continuous ice-sheet, being simply the portions of the margin of the continent eroded below the sea level and therefore covered with the ocean waters, which flowed into them as the ice was melted out. And, as we have seen, this action is still going on and new islands and new channels are being added to the famous archipelago. The steamer trip to the fronts of the glaciers of Glacier Bay is now from two to eight or ten miles longer than it was only twenty years ago. That the domain of the sea is being extended over the land by the wearing away of its shores is well known, but in this region the coast rocks have been so short a time exposed to wave action that the more resistant of them are as yet scarcely at all wasted. Even as far south as Victoria the superficial glacial scoring and polish may still be seen on the hardest of the harbor rocks below the tide-line. The extension hereabouts of the sea by its own action in post-glacial time is probably less than a millionth part as much as that effected by recent glacial action.



LARGE ROCK CARRIED FROM DISTANT MOUNTAINS TO THE SEA BY A GLACIER.

On our way up the coast to Yakutat the majestic Fairweather Mountains we had so often admired from the Glacier Bay side were buried in clouds, but the broad outspread lower portions of the glaciers were clearly displayed beneath the clouds up to an elevation of about 2,000 feet. All of them are cut off from the sea by enormous moraine deposits, except a mile or two of the front of La Perouse Glacier which presents a bold crystal wall to the waves at high tide. Not a single iceberg

was seen. That there should be no discharge from the sea side of the Fairweather Range and so lavish a discharge from the other is not so surprising, however, when we consider that the area of the western slope and its snowfields is far less extensive, while at the same time the waste from the sea winds and from sunshine, on account of the direction of the trend of the Range, is greater. A landing was made near the west end of the La Perouse ice-wall to examine a forest, part of which had been overwhelmed by an advance of the glacier; another part was falling by the undermining action of a glacial stream. Some of the Taylor Bay and Prince William Sound forests have been destroyed in the same way, whether simultaneously or not I am unable to say. When I visited the Brady Glacier in the summer of 1880 I found thousands of trees, many of them more than a century old, which had been uprooted and crushed like weeds before the plow, showing that this glacier, instead of receding, had risen higher and advanced its front beyond the position where it stood when Vancouver explored the bay in 1794. The trees lining the banks were barked and scarred, very effectively blazing a high ice-mark for miles. The surface of the glacier had already fallen fifteen or twenty feet below its highest flood-level, though the front had receded but little; its huge ice-cliffs on the east end were still towering portentously above the spruces that stood a few feet in front of them. The buried forests of Glacier Bay record still greater and more impressive changes in the recession and advance of grand ice floods and water floods.

In our northward journey dark clouds hid the mountains until we reached Yakutat. Then the heavens opened and St. Elias, gloriously arrayed, bade us welcome, while the heaving, plunging bergs roared and thundered.

Here we spent immortal days, studying, gazing, sailing

the blue waters, climbing the hills and glaciers and warm, flowery islands, considering the abounding life—everybody naturally enthusiastic and busy and happy to the heart. The scenery about the head of Disenchantment Bay is gloriously wild and sublime—majestic mountains and glaciers, barren moraines, bloom-covered islands amid icy, swirling waters, enlivened by screaming gulls, hair seals, and roaring bergs. On the other hand, the beauty of the southern extension of the bay is tranquil and restful and perfectly enchanting. Its shores, especially on the east side, are flowery and finely sculptured, and the mountains, of moderate height, are charmingly combined and reflected in the quiet waters. A comparatively short time ago it was a fresh-water lake about 150 feet above the tide—until it was lowered and opened to the sea by the retreat of the Hubbard Glacier. The front of the great Hubbard Glacier is about five miles wide, and bergs are discharged from the west half of it. The other half has receded from the bay and is



NUNATAK GLACIER.

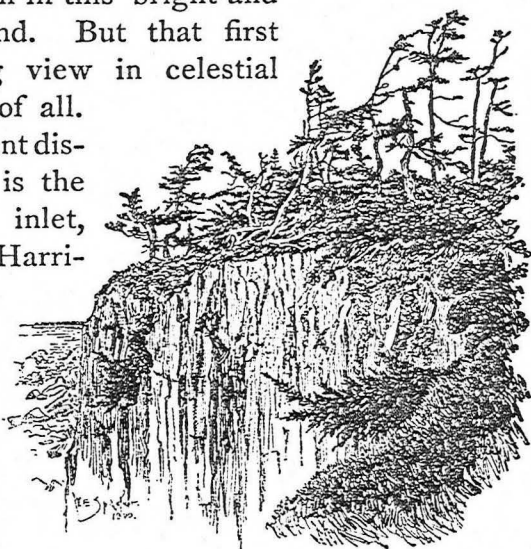
covered with moraines, sparsely planted here and there with epilobium and dwarf willows, where a multitude of gulls breed. The Turner Glacier, a short distance to the west of the Hubbard, is much smaller and sends off but few bergs. The Nunatak Glacier discharges still

fewer, and at the present rate of waste will soon die away into the second class, like its neighbor, the Hidden Glacier.

For an hour or two before we left Yakutat we enjoyed glorious views of Malaspina's crystal prairie, and of St.

Elias and his noble compeers, then down came clouds and fog, leaving only a dim little circle of water about us. But just as we entered the famous Prince William Sound, that I had so long hoped to see, the sky cleared, disclosing to the westward one of the richest, most glorious mountain landscapes I ever beheld — peak over peak dipping deep in the sky, a thousand of them, icy and shining, rising higher, higher, beyond and yet beyond one another, burning bright in the afternoon light, purple cloud-bars above them, purple shadows in the hollows, and great breadths of sun-spangled, ice-dotted waters in front. The nightless days circled away while we gazed and studied, sailing among the islands, exploring the long fiords, climbing moraines and glaciers and hills clad in blooming heather — grandeur and beauty in a thousand forms awaiting us at every turn in this bright and spacious wonderland. But that first broad, far-reaching view in celestial light was the best of all.

The most important discovery made here is the magnificent new inlet, rightly named the Harriman Fiord. It is full of glaciers of every description, waterfalls, gardens and grand old forests — nature's best and choicest alpine treasures purely wild — a place after



HEMLOCK CLIFF, HARRIMAN FIORD.

my own heart. Here we camped in the only pure forest of mountain hemlock I ever saw, the most beautiful of evergreens, growing at sea-level, some of the trees over

three feet in diameter and nearly a hundred feet high. This is the same species (*Tsuga mertensiana* Sarg.) which grows on the High Sierra of California near the timber line.

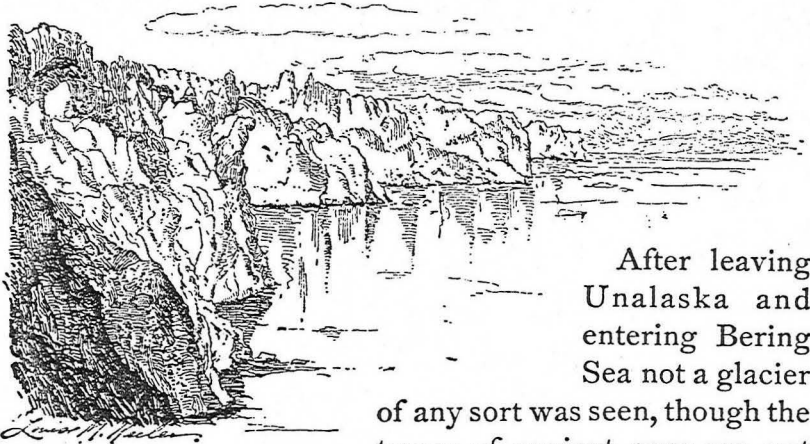


COLUMBIA GLACIER, PRINCE WILLIAM SOUND.

Every feature of Prince William Sound shows that it was once filled by a grand glacier; but, with the exception of its complicated network of fiords, it has long been open to the sea—probably a thousand years or more. On the north shore I found a Sitka spruce 380 years old, and the ruins on the forest floor bear witness to several generations of these trees. And on the shore of the Harriman Fiord, well up toward the head, where the ice must have lingered long after the main central glacier had vanished, I counted 325 annual rings on a hemlock stump only nine inches in diameter.

From this glorious sound we sailed to Cook Inlet, from which most of the great glaciers that once loaded its mountains have vanished; thence to flowery, grassy Kadiak and Unalaska, gaining splendid general views of the wonderful chain of volcanoes extending along the

west shore of Cook Inlet, the Alaska Peninsula, and the Aleutian Islands. Several of the great white cones were sending up plumes of smoke or steam 200 or 300 feet high and sending down broad glaciers nearly to the shore line.



ICE WALL OF COLUMBIA GLACIER.

After leaving Unalaska and entering Bering Sea not a glacier of any sort was seen, though the traces of ancient ones are not rare, especially in the fiords and low mountain ranges. Plover Bay on the Siberian Coast, in which the Expedition made a short stay, and which I explored in 1881, is a well characterized glacier fiord. Its walls rise to an average height of about 2,000 feet and present a severely desolate and bedraggled appearance, owing to the crumbling condition of the rocks, which in most places are being rapidly disintegrated, loading the slopes with loose detritus wherever the angle is low enough to allow it to rest. But on the most resisting portions I discovered rounded glaciated surfaces, grooved, scratched and polished, from near the sea level up to a height of a thousand feet or more. And in high, spacious cirques I found well formed unwasted moraines made up of concentric masses shoved together, indicating that the glaciers to which they belonged receded with changes of level and rate of de-

cadence in accordance with conditions of snowfall, temperature and so on, like those of lower latitudes. When the main glacier which filled the fiord was in its prime it was about thirty miles long and five to six wide, with five main tributaries, which, as the trunk melted, became separate glaciers, and these melting in turn left many smaller tributaries ranging from less than a mile to several miles in length. These, also, as far as I have seen, have vanished, though possibly some wasting remnants may still exist in the snowiest recesses of the mountains.

From Port Clarence we turned back, homeward bound and Heaven-favored, for all the mountains between Prince William Sound and Cross Sound, veiled in clouds on the way up, were now revealed to us in all their glory. The sky was pure azure, the sea calm, and the mountains in their robes of ice and light towered in awful majesty.

In passing the Malaspina Glacier we ran in for a nearer view of the ice bluffs at Icy Cape, then skirted the moraine- and forest-covered border, gaining glorious views of the immense ice-field and its tributaries pouring in from their sublime sun-beaten fountains.

The sail down the coast from St. Elias along the magnificent Fairweather Range, when every mountain stood transfigured in divine light, was the crowning grace and glory of the trip and must be immortal in the remembrance of every soul of us.